REMARKS

Claims 1-30 are all the claims pending in the application.

Response to Claim Rejections Under §§ 102 & 103

Claims 1-9 and 13-19 were rejected under 35 U.S.C. § 102 (b) as being anticipated by Japanese Patent No. 11-043770 ("JP '770).

Claims 10-12 and 20-30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over JP '770.

Applicants respectfully traverse.

The present claims relate to a method for producing a substrate having a carbon-doped titanium oxide layer whereby the carbon-doped titanium oxide layer is produced by (1) directly striking a combustion flame of a gas consisting essentially of a hydrocarbon, against a surface of a substrate having at least a surface layer comprising titanium, a titanium alloy, a titanium alloy oxide, or titanium oxide, to heat-treat the surface of the substrate such that a surface temperature of the substrate is 900 to 1,500°C, or (2) heat-treating the surface of the substrate in a combustion gas atmosphere consisting essentially of a hydrocarbon such that the surface temperature of the substrate is 900 to 1,500°C, thereby forming a carbon-doped titanium oxide layer.

More particularly, according to the present invention, carbon and oxygen are diffused into the titanium at the same time by means of a high reducing flame or a combustion gas at atmospheric pressure without plasma, thereby forming a carbon-doped titanium oxide layer. Thus, the carbon-doped titanium oxide layer has a relatively high content of carbon and contains doped carbon as Ti--C bonds. *See,* paragraph [0025].

Referring to working Example 1; the structure of the carbon-doped titanium oxide layer formed according to the present invention was analyzed according to the following method: Ar ion sputtering was performed for 2,700 seconds using an X-ray photoelectron spectrochemical analyzer ("XPS") at an acceleration voltage of 10 kV and with Al as a target, and analysis was started. When the sputtering speed was 0.64 Å/s (equivalent to that for a SiO_2 film), the depth was about 173 nm. The results of the XPS analysis are shown in FIG. 2. When the binding energy is 284.6 eV, the highest peak appears. This peak was determined to refer to a C-H(C) bond observed generally with C(1s) analysis. The second highest peak is seen when the binding energy is 281.7 eV. Since the binding energy of a Ti-C bond is 281.6 eV, the present inventor confirmed that the C had been doped as Ti-C bonds in the carbon-doped titanium oxide layer of Example 1. *See,* paragraph [0041].

JP '770 discloses "[a] method of forming a coating of glass-like carbon on a titanium metal comprising the steps of forming a dense film of a titanium oxide on the surface of a titanium metal, and forming said glass-like carbon coating on said titanium oxide film by subjecting the surface of the titanium oxide film to <u>plasma heating</u> in an atmosphere containing a hydrocarbon gas under a pressure of 0.1-30 Torr at 400-1100°C." *See,* Claim 1.

JP '770 further discloses that the <u>dense protective film of a titanium oxide can be formed by polishing, preferably buffing</u>, the titanium metal surface into such an extremely fine and flat surface (i.e., an optically reflecting mirror surface that it is possible to perceive that the surface is a mirror surface even with the naked eye). Alternatively, <u>it is possible to form an extremely dense titanium oxide film composed mainly of titanium (IV) oxide</u> not by mirror-finishing but <u>by oxidizing a titanium metal in air at room temperature, in an atmosphere of heated air, or in a forced oxidizing atmosphere</u>." *See*, paragraph [0015] of JP '770.

The dense titanium oxide film prevents or limits the infiltration (carburization) of activated carbon ions into the titanium metal during plasma heating treatment in a predetermined atmosphere under predetermined conditions. Rather, highly amorphous carbon deposits on the surface of the titanium oxide film, forming a highly amorphous, homogeneous, thin glass-like carbon film on the titanium oxide film. *See,* paragraph [0016] of JP '770.

In addition, JP '770 discloses that in order to form a glass-like carbon film on the surface of a titanium metal, the pressure of the hydrocarbon gas should be maintained at 0.1-30 Torr during plasma heating. If the pressure is lower than 0.1 Torr, the amount of carbon in the film tends to be too low to form a complete film, and at pressure higher than 30 Torr, the process is impractical. *See,* paragraph [0025].

An analysis of the crystal structure of the surface formed according to JP '770 indicated that the chemical composition (wt%) near the surface of the gloss film was: Ti: 54%, C: 28%, V: 13%, Sn: 3%, Al: 1% and O: 0.4%. Further, the chemical composition of the β type titanium alloy substrate was: Ti: 65%, C: 2%, V: 22%, Sn: 5%, Al: 3%, O: 1% and Si; 2%. *See,* paragraph [0031] of JP '770.

The above results demonstrate that components detected near the superficial glossy film, are found to be only oxygen and carbon except those chemical elements originating from the β type titanium alloy substrate. That is, it is apparent that no carbide, (i.e., a compound of titanium alloy and carbon) was produced. More particularly, while 2% carbon exists in the titanium alloy substrate, carbon does not exist in the titanium oxide film layer. Thus, JP '770 fails to meet the limitation of independent claims 1 and 2 which call for forming a carbon-doped titanium oxide layer. Namely, as shown above, and particularly in reference to the surface analysis reported in paragraph [0031] of JP '770, the method of JP '770 does not form a carbon-doped titanium oxide

layer and therefore does not anticipate the present claims. Moreover, because JP '770 also does not provide any guidance to one of ordinary skill to modify the method described therein to form a carbon-doped titanium oxide layer, among other reasons, the present claims are also patentable over JP '770. Accordingly, withdrawal of the foregoing rejections and allowance of claims 1-30 is respectfully requested.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

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